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KAY WARD
TEAM LEADER EXAMINATION
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SPECIFICATION
VISION DISORDER REMEDIATION AND ENHANCEMENT DEVICE
June 15, 1999

BACKGROUND

Amblyopia is a defect of vision that affects 4 per cent of the population. Those afflicted with this defect usually have one eye that is unable to hold focus on the fovea in concert with the right eye. Usually the eye with the fixation error also suffers from lowered visual acuity. The higher centers of the visual system in the brain favour the 'good' eye by suppressing the vision through the 'bad' eye. Although this suppression enables the person with **Amblyopia** to see only one vision, this is mostly at the expense of lost binocular vision and stereopsis.

It has been thought that if proper vision is not restored during the formative years of a child, then vision can never be subsequently restored to normal levels of acuity and binocularity.

In some cases, the suppression mechanism of **Amblyopia** is so severe, that after many years, the 'bad' eye can become totally blind.

The treatment for **Amblyopia** has changed little since the discovery of this disorder more than two hundred years ago. This consists mostly of occluding the good eye for long periods and occasional surgery for the more extreme cases. The results, while worthwhile, fall well short of a broadly based remedy.

Strabismus is an eye disorder with some similarity to **Amblyopia** except that there is an ocular fixation eccentricity in both eyes instead of just one. Due to this condition, both eyes do not always

aim simultaneously at the same object. This results in a partial or total loss of binocularity and stereopsis.

Strabismus affects approximately 4 per cent of the population. There are several variations of **Strabismus** such as “esotropia,” “exotropia” and “hyperphoria.” Apart from surgery to remedy severe cases, **Strabismus** can be treated in a similar fashion to **Amblyopia**.

Nobel prize winners Hubel and Weisel in the early nineteen sixties first demonstrated how some layers within the visual cortex respond particularly well to sharp slits of light with sharp, clearly defined edges and widths, of particular orientations and moving at a particular speeds and directions.

The findings of Hubel, Weisel and others that followed them, lead to the CAM visual stimulator by Banks, Campbell, Hess and Watson, of Cambridge University. This early device was based on the assumption that small rotating striped discs should be capable of stimulating the layers of the visual cortex referred to by Hubel, Weisel and others.

The primitive nature of the CAM visual stimulator was such that it was of marginal success at best in the treatment of **Amblyopia**.

The introduction of a light source behind a larger rotating stripped disc of a subsequent design, seemed to be more effective in the treatment of **Amblyopia**.

Dyslexia is a disorder of the eyes of some similarity to **Amblyopia** but one that is far more pervasive and damaging.

Dyslexia is a term used to denote a condition of reduced ability to read and write, in the presence of adequate intelligence, conventional instruction and sociocultural opportunity and without any ophthalmoscopically detectable retinal abnormality. A proportion of those with this condition also display an inability to listen in the absence of any impairment in their hearing.

Some estimates suggest that **Dyslexia** is present in about ten percent of the World population to some degree.

Dyslexia is difficult to detect. Teachers unskilled in the identification of **Dyslexia** may misdiagnose children to be lazy, forgetful, inattentive and unintelligent.

Chronic academic underachievement, sporting ineptitude and an apparent bumbling nature conspire to form an ingrained loss of self-esteem for the youthful Dyslexic. Later for some, this may develop into anti-social behaviour. Others become suicidal. For all, it is a lifetime of unjust treatment and a failure to reach potential as an individual.

It also imposes very high costs on the family trying to understand and to deal with their Dyslexic child.

The British Dyslexia Association says that "**Dyslexia** cannot be prevented or cured, but by teaching appropriate skills and strategies necessary for learning and life, the problems it causes in and out of school can be eased."

Orthoptists, whose regular professional work it is to examine the eyes for eccentricities of fixation, have for some time noted the

existence of an inability of some patients to hold a steady focus. Some of these it had been noticed, displayed the symptoms of visual

Dyslexia.

Given that the Orthoptic knowledge that fixation eccentricities of **Strabismus** or **Amblyopia** caused the higher visual centers of the brain to avoid double vision by suppressing one of the images, it was hypothesised that the disorder of visual Dyslexics was in part the result of a momentary suppression of both images.

Furthermore, neuroscientists in recent years had employed more searching diagnostic techniques to uncover differences in the sectors of the brain utilised by Dyslexics for purposes of reading. Visual Dyslexics were shown not to use their magnocellular pathways, which had evolved to better process fast moving, low contrast objects. Magnocellular pathways were shown to be debilitated in Dyslexics, with smaller, fewer pathway cells and a greater disorganisation in the layers of the visual cortex.

The frontal lobes of the brain in Dyslexics also revealed a greater activity during reading and writing than in non-Dyslexics.

This recent neurophysiological research suggested to the inventor that the treatment of visual **Dyslexia** would involve the rehabilitation of the visual pathways that research had shown were debilitated in Dyslexics and the establishment of fixation stability.

Of particular importance is that *this would involve not the more common palliative approach that is the prior art of treating Dyslexia, but the opposite approach of cognitive exertion during a treatment of enhanced visual cortex stimulation.*

VISION DISORDER REMEDIATION AND ENHANCEMENT DEVICE

Prior art for the treatment of non-retinal eye disorders includes the use of a simple mechanical stimulation apparatus that consists of several rotating discs each covered with stripes of particular width and spacing. Hand drawn transparencies are placed over these disks as exercises to be used by the patient whilst the discs are rotating.

The usual Orthoptic measures of ensuring that binocularity of vision is obtained at the end of this treatment are employed. This consists of initially occluding the dominant eye and filtering the other eye. Subsequently, the dominant eye is filtered uncovering the other eye. The last portion of the treatment involves uncovering both eyes.

This present invention is the combination of the latest neurophysiological knowledge of visual Dyslexia and an innovative application of new technologies, to greatly enhance the scope and effectiveness of the treatment of non-retinal visual disorders such as Dyslexia than was possible in prior art. This includes the treatment of Dyslexia involving the cerebello-vestibular, which is regarded by latest research as being the most common type.

This present invention was conceived with the purpose of enhancing vision for sports purposes in those who do not suffer from eye disorders.

Prior art, as described above, was conceived it seems, from the simplistic view at the time, that the visual cortex consisted of relatively few layers that would respond to relatively few stripes of particular width and fixed spacing behind which diffused light was emitted or only reflected light.

It has been shown that the visual cortex does not have significant stimulation from reflected light and weak stimulation from diffused light.

Furthermore, the visual cortex has not only greater numbers of layers than what was thought at the time of prior art, but that the layers themselves are divided into groups that are interconnected between each other and with close by areas such as the cerebello-vestibular system.

Some of the visual cortex layers involved in the primary processing of neural information coming from the retina, respond only to colour and not to sharp contrasting lines, orientations and movement.

There is also some suggestion that precisely sized and positioned spots of light can also provide some worthwhile stimulation in some of the receptive fields in the visual cortex.

The machines of prior art either did not emit light at all that is essential for the stimulation of the visual cortex area, or emitted

defused light which research has also shown to be a weak stimulator of receptive fields within the visual cortex, as mentioned previously.

Furthermore, the fixed and limited nature of prior art clearly fails to account for, stimulate and rehabilitate the complex receptive fields of the visual cortex or the nearby cerebello-vestibular regions, which current research has identified to be implicated in other major types of **Dyslexia**.

The present invention integrates machine and method through a software driven computerised system. It provides two or three dimensional, interactive and animated vision fields that combine visual and auditory stimulation and cognitive exertion regimes.

This present invention also takes advantage of more recent non-retinal eye disorder knowledge by utilising a computerised system to provide *variable* stimulation with respect to geometry, sharpness, contrast, colour, motion, orientation, perspective and depth.

Linear stimulation

The striped or striated rotating discs of prior art are constantly changing in angle due to their rotation.

The time interval in which the angle of striation inclination is optimum for any particular receptive field within the visual cortex, is therefore very short and occurs only twice per rotation, which at one rotation per minute is once every thirty seconds.

In addition, the velocity of the striations is *radial*, which means the tangential velocity is a maximum at the greatest radius and zero at the center of rotation. This means that the velocity changes according

to how far along the radius away from the center of rotation the patient happens to be looking. Also, as the patient scans his or her eyes across and around the axis of rotation, the velocity of each striation will be constantly changing direction. Hence the velocity and direction of the striations will be constantly changing. This means that the patient is receiving retinal stimulation from slits of light that is constantly changing in direction and velocity. According to the latest neurophysiological research, this is sub-optimal for stimulating and triggering the receptive fields of the visual cortex.

An innovative feature of particular significance in the present invention is the provision of striations that are able to move **linearly** at constant velocity and orientation. The angle, dimensions, spacing, velocity, luminance and contrast and colour gradation can be adjusted by the Clinician. Hence the striations are capable of stimulating a particular layer of the visual cortex for a far longer period, wherever the patient happened to be looking on the cognitive exercise target.

Such a newly found capability would ensure that complex cells are triggered to their maximum and that simple cells could be triggered more often.

A greatly enhanced capability of visual stimulation and the addition of auditory stimulation as provided by this present invention, will enable new ways of stimulation to be found, which will be more effective and include more areas of the brain.

It is also known that the degree and area of debilitation varies within patients. In an embodiment of this present invention discussed

later in this application, there is the capability of integration with non-invasive brain function investigative devices such as a functional Magnetic Resonance Machine, which enables the activities of the brain to be observed during diagnosis and treatment.

A computer controlled diagnostic program that methodically exposes the visual cortex to the full spectrum of linear motion striation parameters will be able to identify, retain and reproduce a sub-set of those parameters most effective for a particular patient. The treatment according to the present invention can then proceed to ensure that the receptive fields with simple cells are given their appropriate orientations much more often and the receptive fields with complex cells are presented with linear motion of striations that allow more vigorous and longer triggering. This offers the possibility of more effective and shorter treatments.

Given the great number of those suffering from Dyslexia, Amblyopia and Strabismus around the World, the possibility of increasing clinic capacity through a more rapid remediation is a very attractive potential outcome.

PATIENT POSITIONING

Unlike prior art, the concept of 'fractal dimensions' has been employed in the design of the "Vision Disorder Remediation and Enhancement Device," by recognising that dimensions are only dimensions as perceived by an observer and that these depend entirely upon the position of that observer.

Striations on rotating stimulation discs therefore, that have particular and accurate dimensions, need to be always viewed by patients from the same position, if the stimulation is to be fully effective and consistent. For example, Disc 4 when viewed closely could have the same effect as Disc 1 viewed further away for example.

Hence the "Vision Disorder Remediation and Enhancement Device" incorporates adjustable seats and headrests when computer monitors are used, and virtual reality helmets or goggles, in which viewing distance is inherently constant.

When seating adjustments are made in the case of computer monitors, these are made by the Clinician. Settings for both seat height and head rest adjustment are recorded and stored in the memory of the computer system, to be reproduced automatically for that patient at subsequent remediation sessions.

An additional advantage of positioning the patient relative to viewing, is that all the other parameters for treatment such as but not limited to, contrast, colour and luminance, are also more consistently administered to the patient, as all of these also vary with viewing distance.

TOUCH PAD

The patient, once seated, is able to see the vision field on a vertically orientated computer monitor, preferably one with a flat screen. A touch pad, slightly inclined to the horizontal and interacting with the vision field is employed to enable a right or left handed patient to undertake the intellectual tasks presented on the monitor

screen in some comfort, by not having to remove his or her eyes from the monitor. The touch pad also allows the Clinician to interact with the patient more easily and without disturbing the patient's focus on the stimulation vision field.

An added benefit is that the need to use the touch pad itself is a task that adds to the cognitive effort, which is one objective of the treatment of this present invention.

HARDWARE

Monitor - Patient

The "Vision Disorder Remediation and Enhancement Device" employs the latest in high resolution, high colour fidelity and flat screen technology, to allow close quarter, intense viewing by patients with minimum fatigue.

The screen has a square view area of at least 0.5 square meters, in order to eliminate peripheral distractions. Screen resolution is at least the equivalent of 1,200 by 1,200 pixels.

A screen touch capability is also provided as part of the remediation treatment according to this invention.

The monitor will also have the capability of providing uniform, high intensity, and high-fidelity lighting with fine adjustment of contrast and colour, either by the Clinician or by software.

Monitor – Clinician

A separate monitor, orientated and shielded from view of the patient is provided for viewing by the Clinician working with the patient. The monitor will display gridlines, graphical and numerical

information not seen by the patient, quantifying for the Clinician how the patient is performing.

Central Processing Unit

The central processing unit is capable of providing high-end, three dimensional, high-resolution, interactive animated graphics, with high fidelity sound. There is provision for adding auditory, somatosensory and kinesthetic testing peripherals, as well as for sport-specific interactive simulator modules.

Hard disc storage is provided of sufficient capacity for storing an animated graphics treatment record for each patient. An independent DVD storage system or similar, is also provided to keep a backup of all patient treatment records.

Sports Vision

Most sports require the ability to see fast moving objects clearly and to judge their position and trajectory accurately at all times and in various viewing conditions.

A high level of performance in conditions as above, requires a high standard of binocular vision and a healthy stereopsis for good depth perception. This requires a high standard of acuity in both eyes as well as well developed magnocellular and parvocellular pathways.

From prior Orthoptic material, it has been shown that some persons without a visual disorder had exhibited some enhancement of visual acuity when treated with an apparatus fitted with rotating striations as used in the public domain for the treatment of 'Amblyopia.'

The "Vision Disorder and Enhancement Device" employs the latest technologies in creating a dedicated treatment for the enhancement of sports vision.

This treatment seeks to expand the vision envelope of the patient as appropriate to that specific sport with respect to depth perception, visual acuity and ability to see fast moving objects under difficult conditions.

The first stage of the treatment for sport vision would enhance binocularity and exercise the visual pathways systems in a similar way to what is done for patients with a visual disorder.

This cognitive exertion regime employed would also involve accurate three-dimensional images of high resolution that are accurate with respect to depth and are sport specific. As one example, the full spectrum of tennis serves as perceived by a receiver would be reproduced, altering velocity, spin, bounce, direction, colour brightness and contrast. These images would also include particularly demanding conditions for an incoming volleyer or demanding conditions for a baseliner.

When a virtual reality helmet or goggle is employed, a device similar to the actual racquet or bat would be utilised, with internal inertial triggers to simulate the feel of impact. The patient then can stand up and move his or her hands in response approaching balls in the vision field as appropriate to that sport. This treatment has the added advantage of also enhancing eye hand coordination as appropriate to that sport.

SOFTWARE

SCOPE

Disorders of Vision

The "Vision Disorder Remediation and Enhancement Device" is designed to treat different forms of Dyslexia, Amblyopia, Strabismus and other non retinal eye disorders by utilising discrete, dedicated software packages, developed from Research and Development performed with the "Vision Disorder Remediation and Enhancement Device".

The "Vision Disorder Remediation and Enhancement Device" will provide cognitive exertion tasks interposed with stimulation regimes which are an essential part of the treatment of disorders according to this invention. These will be available in multiple levels of increasing depth and scope.

This stimulation regimes could include the rotational striations of prior art but in parametric form to allow wide ranging adjustability that is not possible in prior art.

As one example, the spacing between striations is critical to elicit the maximum strength of stimulus response in the receptive fields of the visual cortex. In prior art, the width of the striations and spacing between them is fixed by the series of physical discs

employed. It is unlikely that the slit widths of light presented to the receptive fields will always be optimal. The width of striations coupled with rotation speed determine the recovery time of receptive fields that have been triggered and therefore their degree of cell recovery before the next slit of light passes over them. It is also unlikely that there will be the optimum amount of recovery time between triggerings.

Of far greater importance is that the present invention allows **linear stimulation** regimes as discussed subsequently.

With the ongoing Research and Development that is now possible with the present invention, further levels will be introduced using three dimensions and involving the stimulation of parts of the visual system now not identified or remediated.

Sport Specific Vision Enhancement

The "Vision Disorder Remediation and Enhancement Device" is also designed to enhance the ability of a patient not suffering from specific eye disorders, to follow fast moving objects, approaching at different angles, trajectories and velocities, in a viewing environment that is sport specific.

SOFTWARE OTHER

Parametrics

The software will provide for parametric capability with respect to geometry, shape, colour, texture, colour gradation and movement. This enables the degree of stimulation and cognitive exertion to be tailored to the patient with respect to disorder type and degree. Each particular parametric state will be stored in a database and labeled for specific patient types.

For sport specific vision enhancement, the parametrics will focus on the particular vision attributes to be improved.

Interactivity

The software is designed to be animated and interactive, catching and maintaining the patient's interest, starting from the introduction of the patient by name, coaxing throughout the session, and appraisal at the end.

The "Vision Disorder Remediation and Enhancement Device" system is designed so that the clinician need not be present if this is appropriate or be able to be to intervene or interact at any time.

Auditory, Somatasensory and Kinesthetic

Capabilities

As mentioned previously, prior art does not allow treatment of the non-visual aspects of **Dyslexia**. The "Vision Disorder Remediation and Enhancement Device" is a high-powered computer system with a modular architecture connected with high speed communication busses and banks of input and outputs.

The "Vision Disorder Remediation and Enhancement Device" is designed to be integrated with diagnostic equipment of a research standard, in order to categorise the particular reading disabilities that the patient might have, such as dysphonetic, dyseidetic and dysponeidetic types of **Dyslexia**. Such diagnoses would include the presence of cerebello-vestibular disorders that would require a remediation more biased towards phonological neurophysiology. The "Vision Disorder Remediation and Enhancement Device" with provide pre-programmed treatment by audio and visual means, supervised by the Clinician.

VIRTUAL REALITY

It is envisaged that the optimal stimulation regimes will probably have a closer relationship to the reality from which the visual systems had evolved. This suggests that the stimulation fields could consist of three dimensional vision fields approximating real life. This

would require the combining of stimulation and cognitive exertion, and introducing a strong element of the psychological, as is the case in real life when danger appears or when sport is played at a top level.

For this reason, the “Vision Disorder Remediation and Enhancement Device” incorporates as part of its treatment, special purpose ‘virtual reality’ helmets to better create an interesting real-life experience that also provides optimum stimulation and cognitive exertion.

One advantage by the use of such helmets in this invention is that they enable each eye to be stimulated and exercised separately. Hence disparities in visual acuity can be accommodated during treatment without the need for lenses. Regression to the ‘good’ eye can be kept at bay with minimal colour adjustments or partial occlusion, thus keeping the ‘bad’ eye loaded to the maximum whilst ensuring that binocular fixation and therefore appropriate binocularity is maintained. This can be achieved by incorporating short, periodic, checks and make real-time adjustments to the vision field, to ensure that regression to the good eye does not occur.

Another advantage in the use of such helmets is that no adjustment is required to ensure that the patient is viewing at a constant distance, as previously mentioned.

Integration with Functional Magnetic Resonance Imaging Machine

The use of a virtual reality helmet or goggles overcomes the particular physical constraints of using non-invasive investigative technique such as a functional Magnetic Resonance Imaging Machine simultaneously with the "Vision Disorder Remediation and Enhancement Device". This integration will initially be used for Research and Development, and subsequently also for Clinic use.

The capacity for employing the "Vision Disorder Remediation and Enhancement Device" simultaneously with a functional Magnetic Resonance Imaging Device for example, enables the brain to be seen "thinking" during a precise and structured diagnostic and remediation session.

This offers not only the scope for an accurate initial neurophysiological diagnosis of the patient and the neurophysiological proof of a successful treatment, but also the possibility of optimal adjustment to the numerous parameters for stimulation of the visual pathways and the cerebello-vestibular regions of the brain as previously mentioned.

VIRTUAL RETINAL DISPLAY

Current virtual reality technology involves recreating miniature screens in helmets or goggles, which the eyes are required to see at close range. The resolution, colour intensity, fidelity & contrast that is currently possible under these conditions is inferior to what can be

achieved in conventional screens. As a consequence, this present invention employs currently available helmets or goggles as a supplementary treatment to the main portion of treatment provided by high-resolution monitors.

A new technology is being developed by another party, does not require conversion of computer images generated into a multitude of discrete parcels that first have to be shown on a screen. The eyes in conventional technology receive light reflected and emitted from an intermediate source - the images created on a screen. This new technology is called 'Virtual Retinal Display' technology. It involves the elimination of the intermediate source of image creation, projecting computer-generated images directly onto the retina.

This technology is ideal for this present invention, because it will allow images of high resolution and colour fidelity to be shown individually to each eye, in helmets or goggles. Furthermore, the embodiment required for Virtual Retinal Display technology is ideal for the monitoring in real-time the fixation of each eye individually. This is particularly useful to the diagnosis, enhancement and monitoring of binocularity and stereopsis, which is fundamental to the treatment from which the current invention has evolved.

Virtual Retinal Display technology is being developed in a way that would allow it to interface with the 'Vision Disorder Remediation and Enhancement Device'. This would allow an easy progression from conventional helmet and goggle display technology, which is a supplementary portion of the treatment as per this invention, to a

helmet and goggle treatment that could become the major portion of the treatment and according to this invention.

Bio-feedback

The Virtual Retinal Display helmets could also enable each patient to see the fixation eccentricities in the vision field like a 'head-up' display of a modern fighter plane. The biofeedback loop may help some patients with disorders like Strabismus learn to 'feel their eyes' into bimaocular fixation.

PREFERRED EMBODIMENT

A preferred embodiment of the invention is shown in **Drawing 1**. This shows the patient sitting in front of and looking directly at a vertical flat screen whilst writing on a pad, inclined for comfort. The pad is integrated with the image on the monitor, such that the patient is able to write and draw on the pad, without having to look downwards and be able to see his or her drawing appear in the image on the monitor.

The filtering and occluding goggles, which are an integral part of the treatment as in this invention, are not shown for reasons of greater clarity. Similarly, the adjustable power seat is not shown, nor the parent sitting on the left-hand side of the patient, opposite to the clinician seated on the right-hand side of the patient.

The patient will be subjected to the usual Orthoptic binocularity measures of filtering and occlusion as mentioned previously. These will be incorporated automatically and with greater adjustment and

precision with the use of virtual reality helmets or goggles as mentioned later in this application.

The image on the screen has a graduated stimulation regime interposed with exercises whose purpose is to exert the maximum cognitive effort that the patient is able to muster.

The Clinician is shown sitting at the side looking at an inclined monitor, which displays not only the identical images that the patient sees, but also other information of interest to the Clinician. Such information would include but not be limited to, the name of the patient, some essential details on the patient, the number of the session, the elapsed time of the session, the elapsed time of each segment of the treatment, the combination of stimulation background and cognitive exertion package being employed, and how the patient is progressing against the cumulative statistical profile of similar patients.

Preferably, there are high fidelity audio speakers on either side of the monitor. These in combination with the monitor, will provide a personalised audio-visual introduction and conclusion to the treatment session, as well as add an auditory element to the treatment. Apart from providing a more interesting dimension to the cognitive exercises in the form of supplementary noises, comments and melodies from time to time, the audio system would emit exercises intended to diagnose for the presence of any phonological impairment. If such an impairment is detected, then the Clinician would select a treatment from the “Vision Disorder and Enhancement Device” data bank to include cerebello-vestibular remediation.

This will preferably involve the integration of the “Vision Disorder Remediation and Enhancement Device” with a non-invasive device machine such as a functional Magnetic Resonance machine. A combination of phonological and visual diagnoses and treatments will be administered through the auditory and visual capabilities as available in this invention. The integration of these will be able to confirm the areas of debilitation, adjust and administer the treatment according to the particular condition of a patient, and confirm the efficacy of the treatment.

Drawing 2 shows a side view of the preferred embodiment. Powered seating with memory is shown that allows the patient to be positioned correctly without introducing fractal dimensional errors.

Also shown in **Drawing 2** is the monitor of the Clinician and an inclined keyboard in front of it. Behind the monitor screen of the Clinician but not shown in **Drawing 2** are input-output modules for the multi-sensory diagnostic devices and for the sports vision enhancement devices.

To the right of the Clinician are the parametric control modules, which can modify the contrasts, angles, widths and spacing of striations, in addition to the number, colours, velocities and directions of dots, as shown in views 1) 2) 3) 4) 5) 6) 7) & 8) in **Drawing 3**, as well as introduce interposed cognitive exertion exercises as shown in **Drawing 4**. The latter drawing shows an exercise such as might be used for a child, which consists of moving coloured dots with words on them, moving underneath striations

moving in the opposite direction. The child is required to make a pre-determined sentence with the words by pointing to the dots and dragging them into a stationery position on the bottom of the monitor screen. The moving striations continually cover and uncover the words requiring rapid eye movements, rapid fine detail recognition and good short-term memory.

Such exercises can be made cognitively more difficult by using more difficult language, many more similar but incorrect words, in dots that are difficult to see and moving at progressively greater velocities as controlled by the Clinician. By measuring the time to find and arranged the words as required in any give exercise regime, allows a scoring system to be developed, which is visible only to the Clinician.

These exercises are cognitively and visually more difficult because of their contra-motion, use of dots as well as striations, as well as requiring high speed language recognition, and demand on motor function skills.

A preferred embodiment of this present invention, is when the patient is diagnosed with 'virtual reality' goggles integrated with the present invention and a functional Magnetic Resonance Imaging machine, or some similar device, as shown in **Drawing 5**. As previously mentioned, this embodiment enables a comprehensive diagnosis to be performed by exposing the patient to a systematic regime of visual tasks and corresponding stimulation regimes as is available by the present invention, as well as being able to see the

corresponding activity in the brain. An optimum sub-set of visual tasks and corresponding stimulations can be obtained for each patient, then recalled and used in the treatment program such as shown in

Drawing 1.

Preferably, 'Virtual Reality' goggles are to be used in cases when there are significant acuity differences between eyes of the patient so that the images can be adjusted in situ without the need for corrective lens.

The advantage of employing goggles as above, is that maximum stimulation to the weaker eye can be administered by controlling the point at which regression to the dominant eye occurs. This is done by the Clinician who observes the fixation behaviour of each eye separately and adjusts the intensity, wavelength and contrast of filtered light being applied to the good eye when appropriate. With 'Virtual Reality' goggles this can be done progressively at the optimum point by the Clinician at the workstation. No such adjustment is possible with prior art.

This is diagrammatically shown in **Drawing 6** which shows a binocular vision field from such goggles such as might be seen by the patient as in **Drawing 5**. In **Drawing 6**, an adjustment in size is shown for acuity differences, filtering is in place for the dominant right eye (the slightly darker appearance of the right eye view field) and the actual fixation points (black dots) are shown relative to the exact foveal position are indicated by the cross lines at center of the vision field. In **Drawing 6**, the interposed cognitive exertion exercises are

omitted for clarity. These will be developed to utilise the advantages that the new technology according to this invention allows, a simple example of which is as shown in **Drawing 4** which is the forerunner of 'Dynamic' cognitive exertion exercises which will be two and three dimensional.

The left eye is shown in **Drawing 6** with a fixation eccentricity for illustrative purposes. This indicates that the patient is still viewing through the dominant right eye with essentially monocular vision. Such a situation could occur at the beginning of the treatment sessions. The Clinician would in this case, occlude the right eye totally, and introduce a difficult wavelength into the left eye in order to exercise the visual pathways and the higher levels of the entire vision perception system.

In the preferred embodiment for **Sports Visions Enhancement**, the touch pad will be organised in a fine grid, which is integrated into the three-dimensional, high resolution, high accuracy of perspective animated images specific to a particular sport. The patient will need to place a finger on the grid in response to an accurately represented fast travelling ball. If the finger is placed on the right portion of the grid at the right time, the patient will be rewarded with the sound of a hit or a catch. In the case of a hit, a starburst at the time of impact that can be seen on the screen, as shown in **Drawing 7**.

The specification of the image and the performance of the patient will be to a high scientific standard, so that the conditions on the screen can be progressive made more difficult, according to the particular

attributes of the patient as well as accurately recording the progress of the patient.

The patient will have the opportunity to practice on the pad before the treatment commences. There will be no need for the patient to lift his or her eyes away from the screen because any finger touch on the pad will be seen at its relative position to the ball on the screen.

At the end of the Sports Vision treatment, the measurements for both eye acuity, stereopsis, accuracy and timing statistics for the treatment program will be presented to the patient.

WE CLAIM:

1. An apparatus for treating **Dyslexia, Amblyopia and Strabismus** comprising the presentation of computer generated visual images and auditory inputs so as to strengthen the visual and phonological pathways of a patient and provide interactive work exercises on said images by means of an external physical device utilized by the patient.
2. An apparatus as claimed in claim 1 where the external device is preferably an interactive tablet upon which the writing of a patient can be seen in the said images as in claim 1.
3. An apparatus for enhancing the vision of a patient so as to better see fast moving objects moving at any angle towards or away from the patient, and improving the eye to hand coordination therefrom, comprising of same

said apparatus as in claim 1 with same said visual images or other images with same said external physical interactive devices or other external physical interactive devices.

- 4 An apparatus as claimed in any of claims 1, 2 & 3 where the images may be presented to the patient by means of helmet or goggles or eye glasses or any means other than by a computer monitor screen.
- 5 An apparatus as claimed in any of claims 1, 2, 3 & 4 where the visual images presented to the patient are integrated with a non invasive device such as a functional Magnetic Resonance Imaging Machine capable of displaying real time visual representations of brain activity, preferably enabling a person other than the patient to simultaneously view the vision field of the patient and the patient's corresponding brain activity.
- 6 An apparatus as claimed in any of claims 1,2,3,4 & 5 where the visual images are preferably 2 or 3 dimensional and preferably moving.
- 7 An apparatus as claimed in any of claims 1,2,3,4, 5 & 6 where the said visual images are preferably accompanied by sound.
- 8 An apparatus as claimed in any of claims 1,2,3,4,5, 6 & 7 where the said visual images preferably can be accompanied with auditory, somatosensory and

kinesthetic work exercises assisted preferably by external physical interactive devices.

- 9 An apparatus as claimed in any of claims 1,2,3,4,5,6, 7 & 8 where the said visual images preferably can be transmitted via internet from a central location, uploaded and downloaded with a speed that is commercially viable for the operation of global clinics.
- 10 An apparatus as claimed in any of claims 1,2,3,4,5,6, 7, 8 & 9 where the said images can preferably be adjusted for colour, colour brightness, colour gradation, contrast, shape, geometry, motion, direction, texture and sound by either by preprogrammed selection by the Clinician or any other person, or each individual characteristic as mentioned in this claim 10 can be chosen and individually adjusted by the Clinician or any other person.
- 11 An apparatus as claimed in of claims 1,2,3,4,6,7,8,9 & 10 where the said images can preferably be also viewed by any person other than the patient, simultaneously, separately, or at any subsequent time by means of a computer monitor, helmet, goggles or eye glasses.
- 12 An apparatus as claimed in of claims 1,2,3,4,6,7,8,9,10 & 11 where the said images as in claim 11 can be viewed with any additional interposed visual information not visible to the patient during treatment.

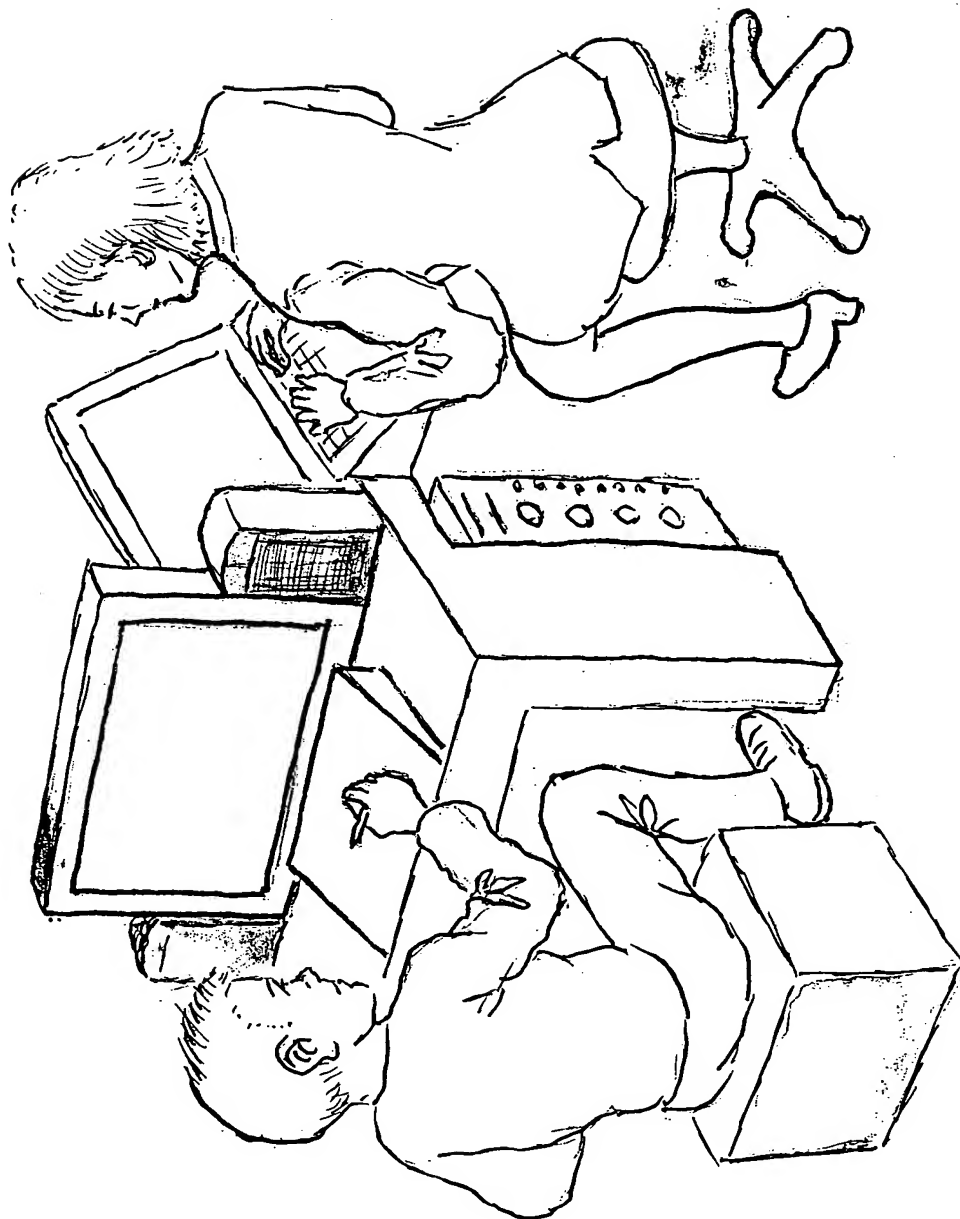
13 An apparatus as claimed in of claims 1,2,3,4,6,7,8,9,10
11 & 13 where the additional interposed visual
information as in claim 11 and claim 12 provides either
diagnostic information as to what type of Dyslexia the
patient has and the condition of it before, during and
after treatment.

14 An apparatus as claimed in of claims 1,2,3,4,6,7,8,9,10
11, 12 & 13 where the means of chosen viewing is only
by computer monitor, a preferred further modification is
to adjust the seat height and head rest of the patient so
as to place the eyes of the patient in a particular position
relative to the computer monitor from which the
simulating and exercising images will be presented.

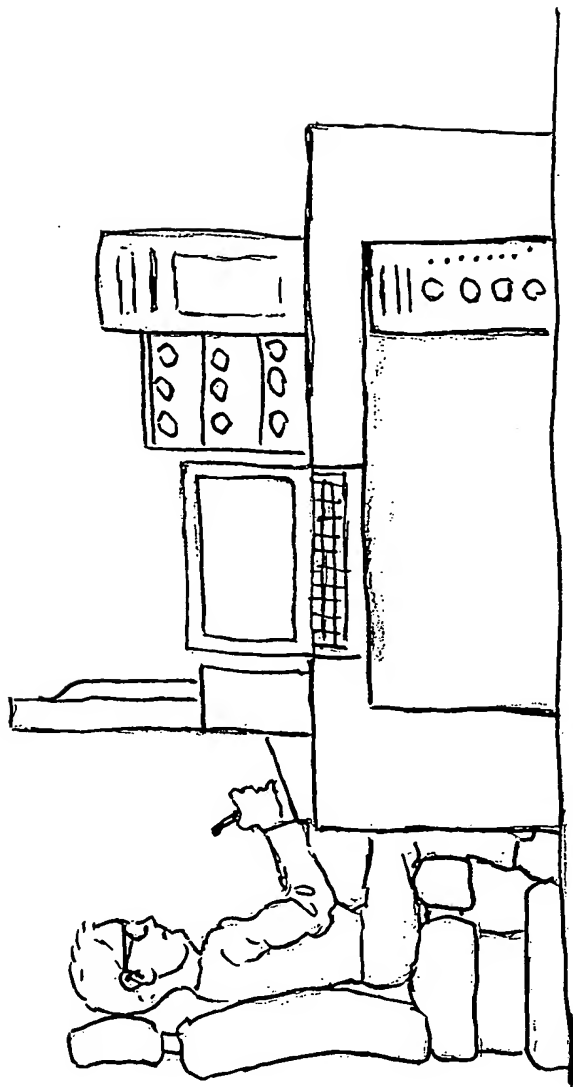
D. Caplygin 15/6/99

Dimitri Caplygin June 15, 1999

VISION DISORDER REMEDIATION &
ENHANCEMENT DEVICE. (VDRE D VICE)
GENERAL ARRANGEMENT
DRAWING ①



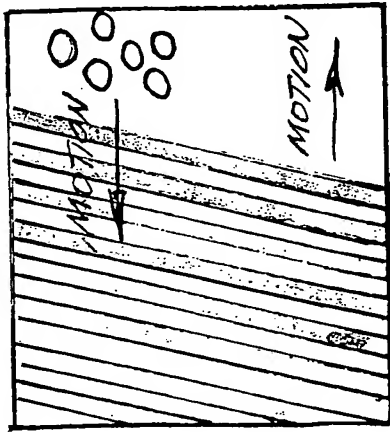
VDRE - DEVICE
SIDE VIEW
DRAWING (2)



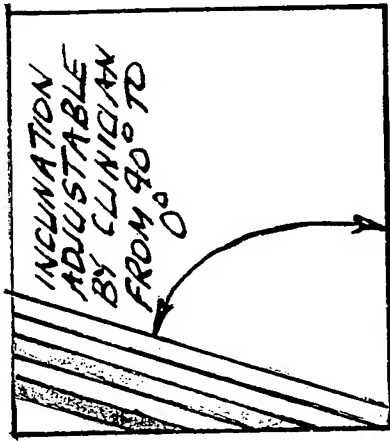
dc
1.11.11

VIBRATOR - DEVICE
LINEAR MOTION STIMULATION
REGIME
DRAWING ③

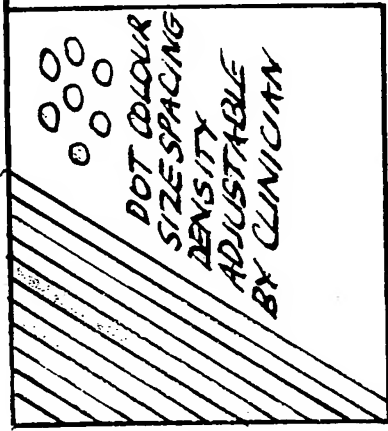
(1)



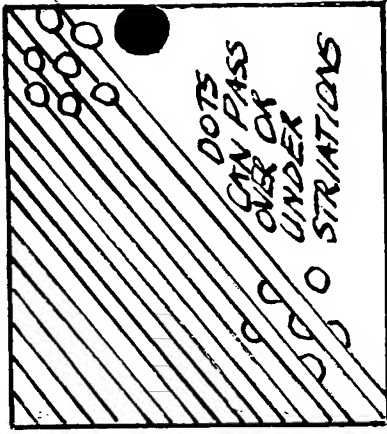
(2)



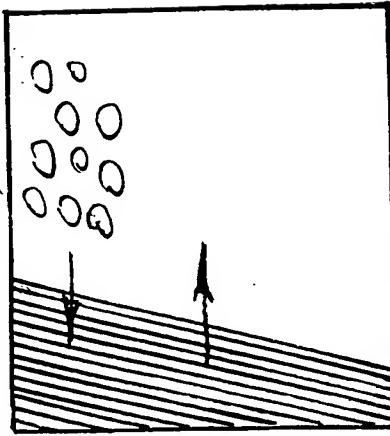
(3)



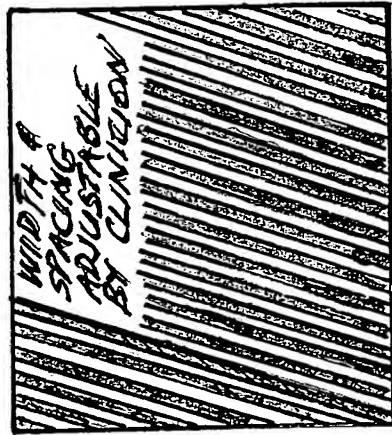
(4)



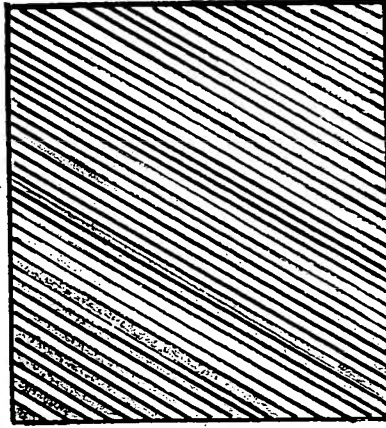
(5)



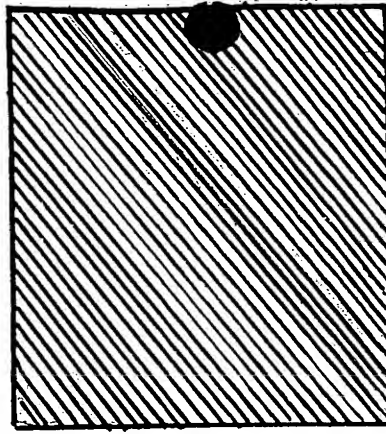
(6)



(7)

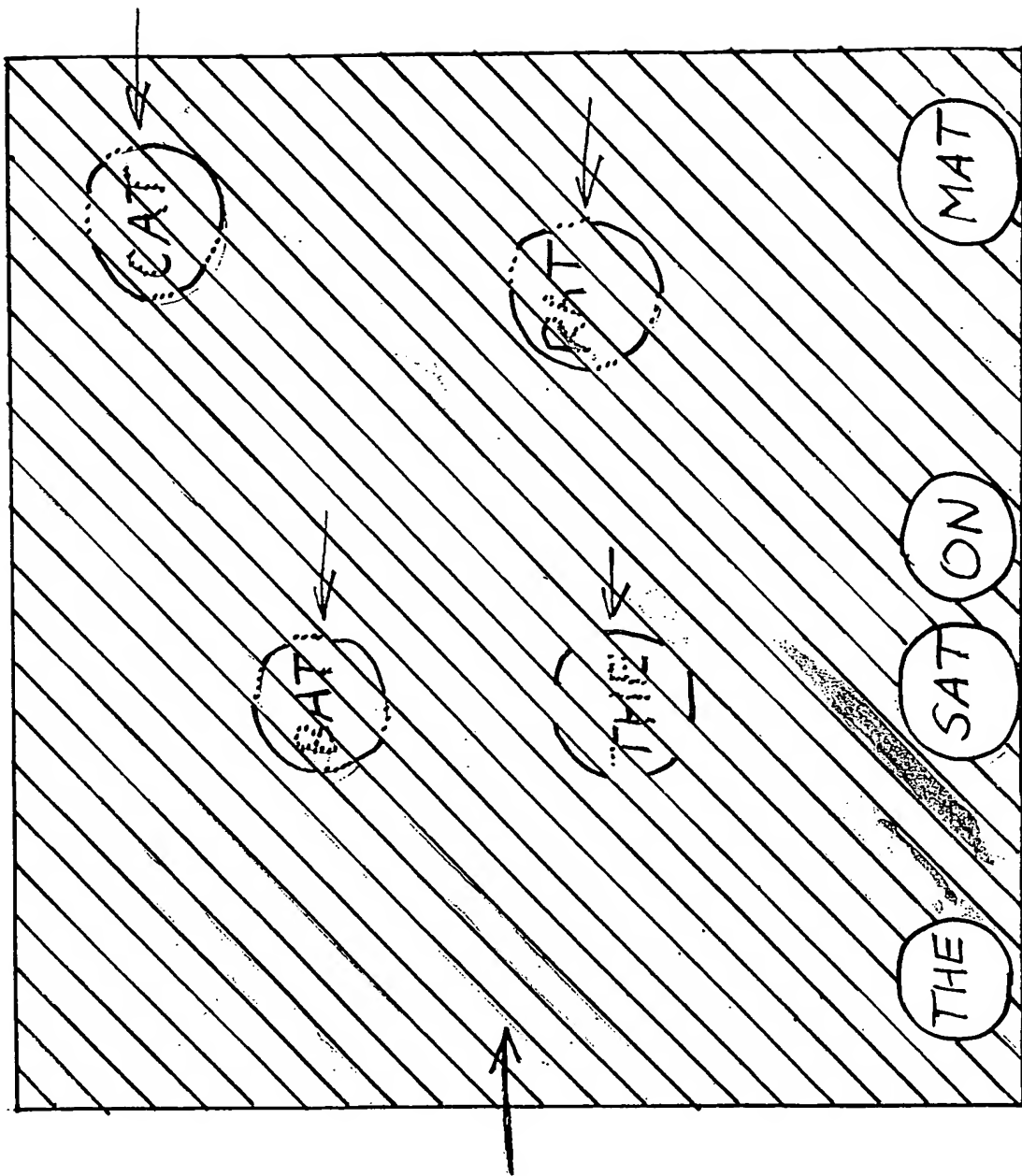


(8)



VDRE DEVICE

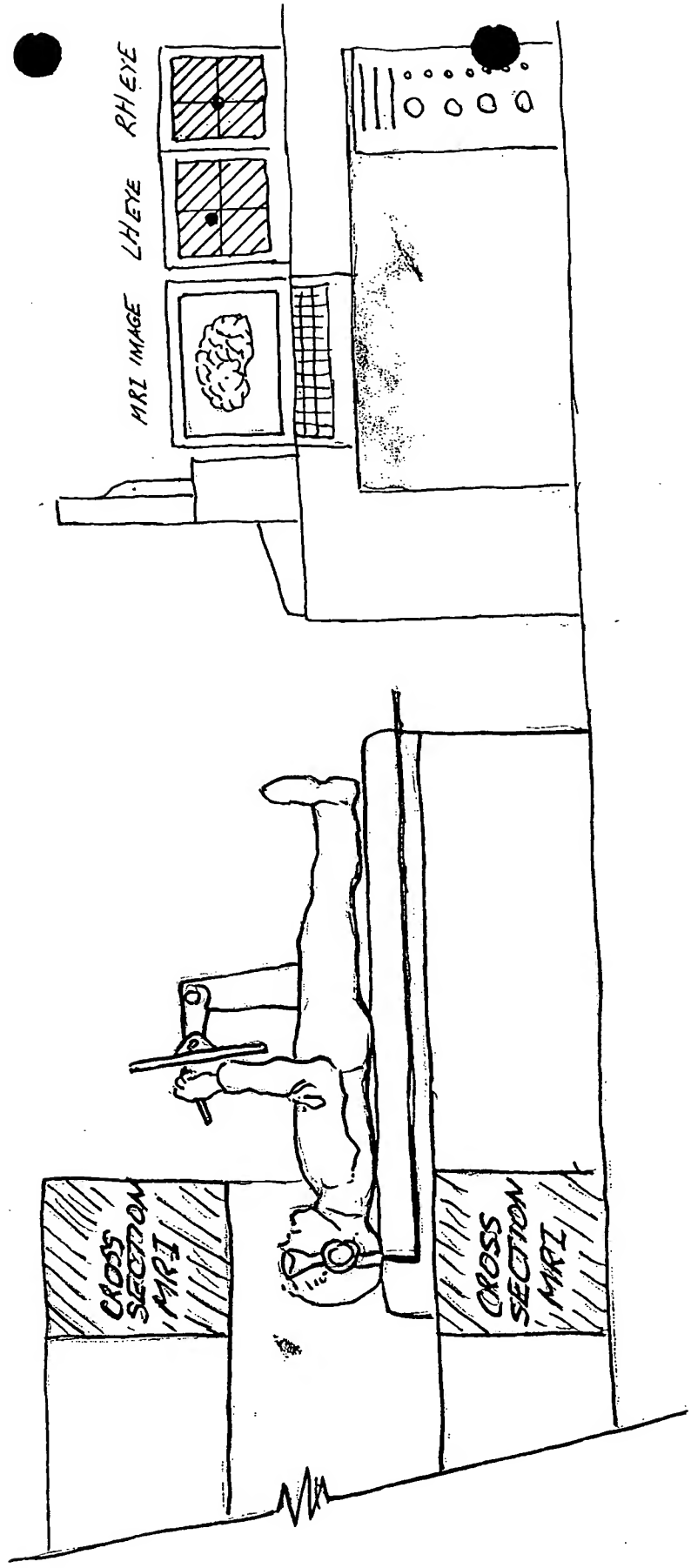
ELEMENTARY COGNITIVE EXERCISE
EXERCISE FOR A YOUNG CHILD
DRAWING 4



R
19/5/99

VORE - DEVICE

INTEGRATION WITH MRI MACHINE
DRAWING ⑤

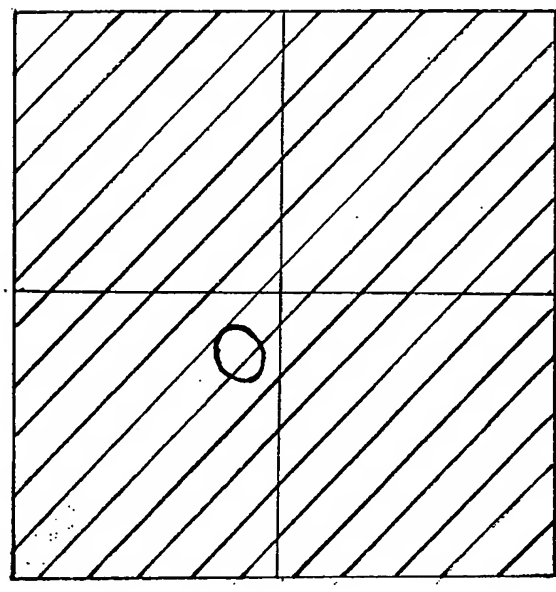


Dr
4/5/99

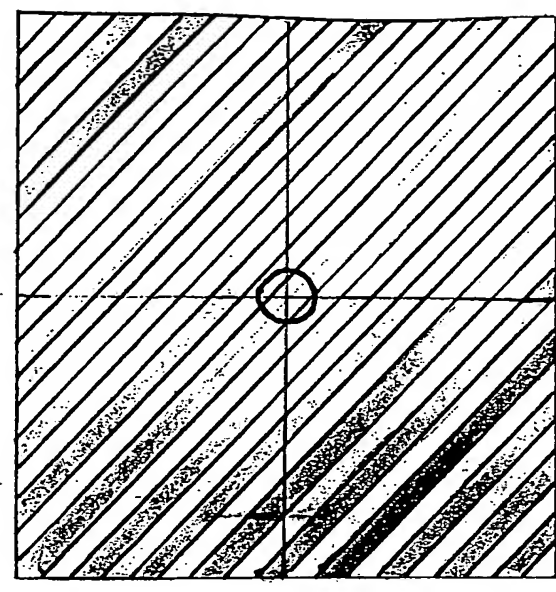
VDRE - DEVICE

BINOCLAR VISION FIELD OF COMPUTER
IMAGE GOGGLES.
DRAWING ⑥

LH VISION FIELD

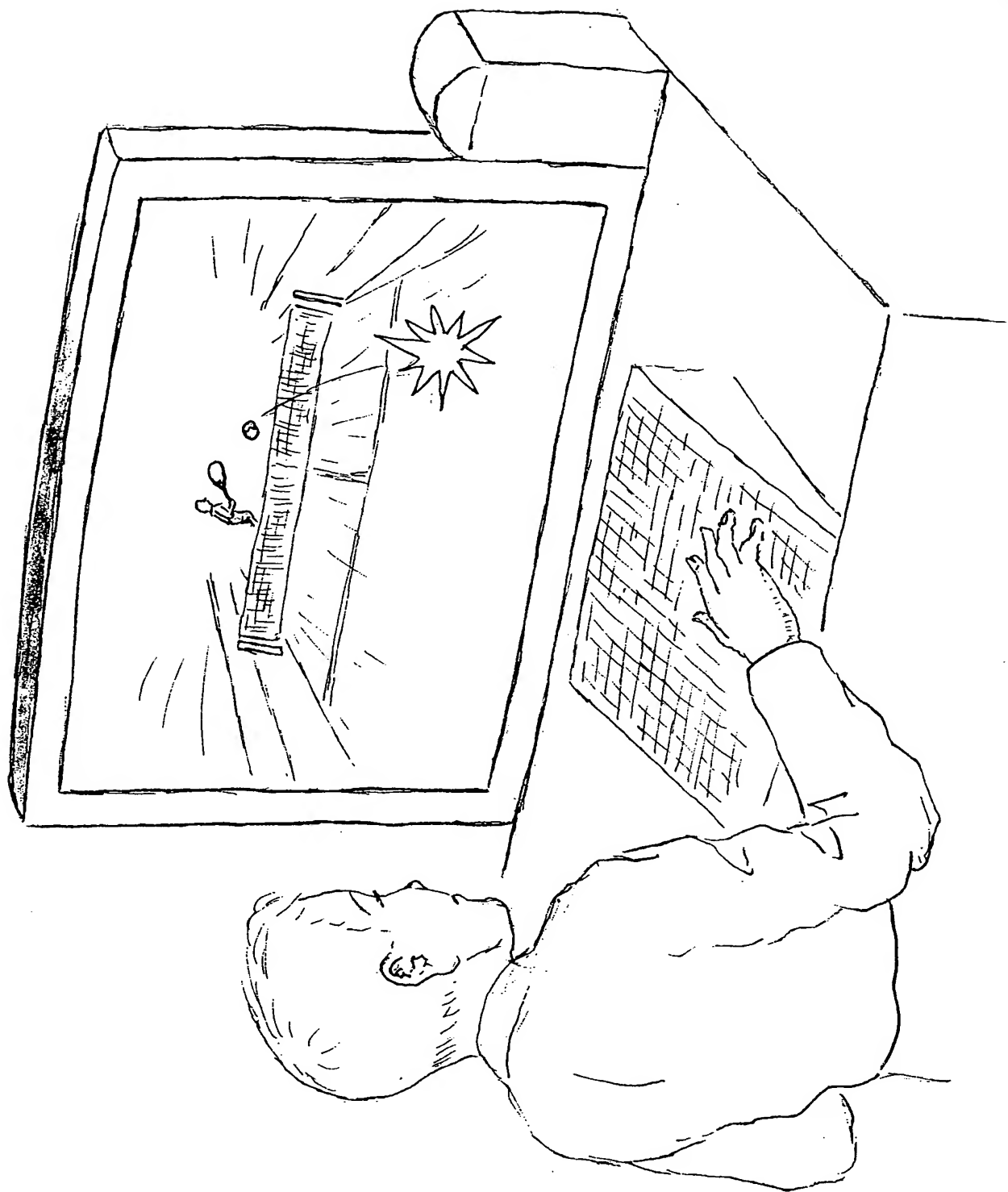


RH VISION FIELD



66/1/14
14/15/99

VDRE DEVICE
SPORTS VISION ENHANCEMENT
DRAWING 7



66/3/41
25

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